ABSTRACT: 236

IMPROVING SOYBEAN´S YIELD PREDICTION OF LATE MATURITY GROUPS WITH CANOPY REFLECTANCE MEASUREMENTS

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Later maturity cultivars develop more above-ground biomass than early cultivars. The Normalized Difference Vegetation Index (NDVI) saturates asymptotically with the increasing of above-ground biomass. In soybean, the R5 stage is commonly defined as the best period to fit NDVI with grain yield. However, it is possible that NDVI saturates in late cultivars because of the moderate to high Leaf Area Index (LAI) developed at the moment of the measurement. The aim of this study was to find the optimum development stage in soybean for different maturity groups, when grain yield best fits with NDVI. A field trial of a Preliminary Yield Test was conducted in Venado Tuerto (lat: -33.873153, long: -61.612113), Argentina. 1664 plots of 1 row and 5 meter lengths were measured with a Crop Circle ACS-430. In the trial, there were pedigrees with maturity groups III, IV, V, VI and VII. The canopy was sensed from vegetative stages to R6 every two weeks. Grain yield at harvest was measured and correlations between yield and NDVI for different maturity groups were compared. In addition, the Wide Dynamic Range Vegetation Index (WDRVI) was also analyzed to improve the correlation when NDVI was saturated by a moderate to high LAI. The results of this study show that grain yield has a strong correlation with canopy reflectance. In cases in which cultivars developed high LAI´s, measurements adjusted better in stages R1, R3 or R6. Cultivars without high LAI´s fitted better with grain yield in stage R5. WDRVI was inconsistent to replace NDVI in high LAI´s situations. There was a negative linear correlation between R^2 of grain yield vs. NDVI, compared with maturity groups. The adjustment between variables had an R^2 of 80% ($P<0,01$). Early maturity groups showed correlations of 79% compared to late groups whose correlation was 38%.

Improving Soybean´s Yield prediction of later maturing groups with Canopy Reflectance Measurements

Ing. Agr. Alejo Costa

Introduccion

- How do active sensors work
- NDVI for different MG
- Adjustments by phenological stage
- WDRVI – Wide Dynamic Range Vegetation Index

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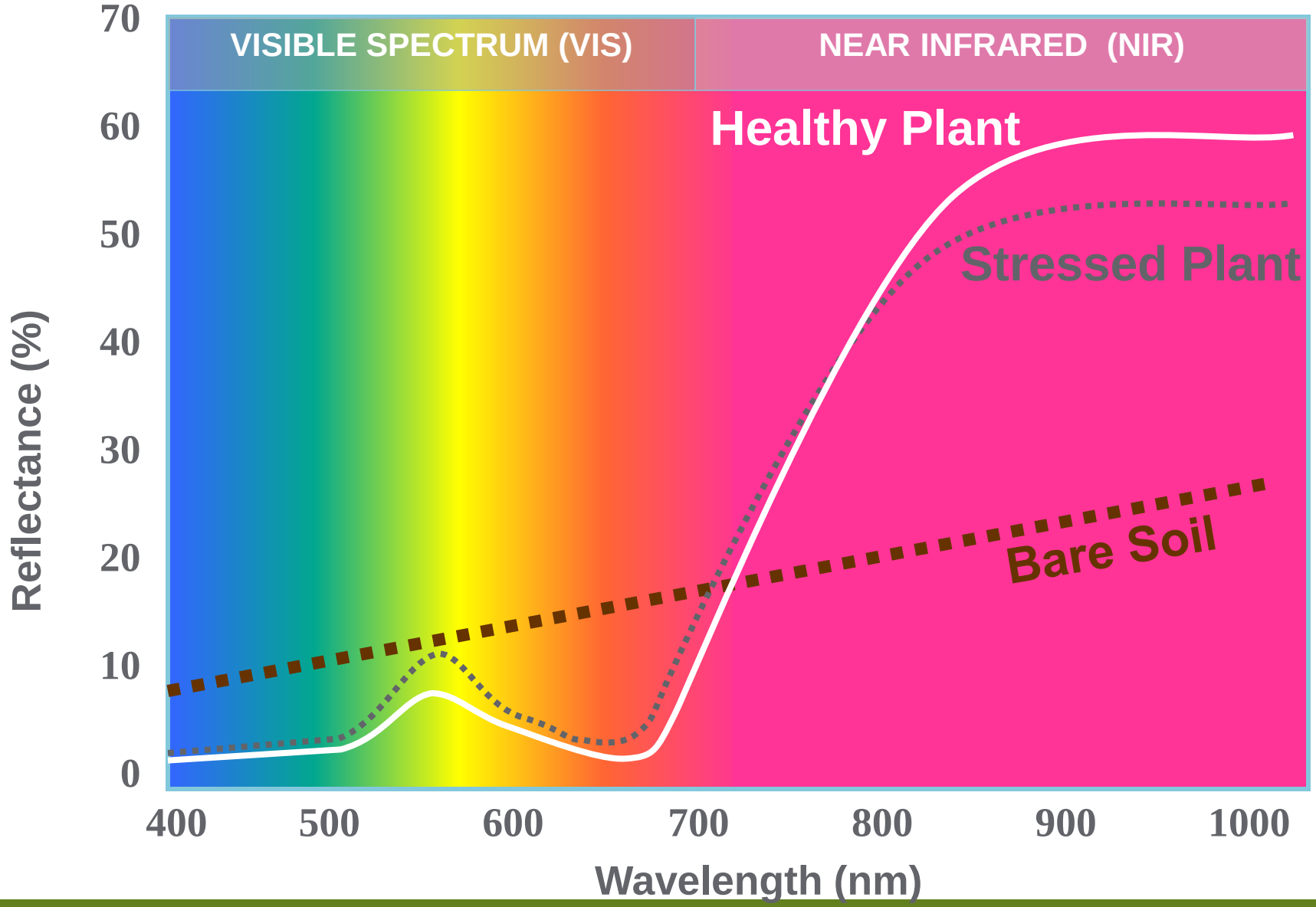
Different spectral ratios measures different plant conditions



Scheppers (InfoAg 2005)

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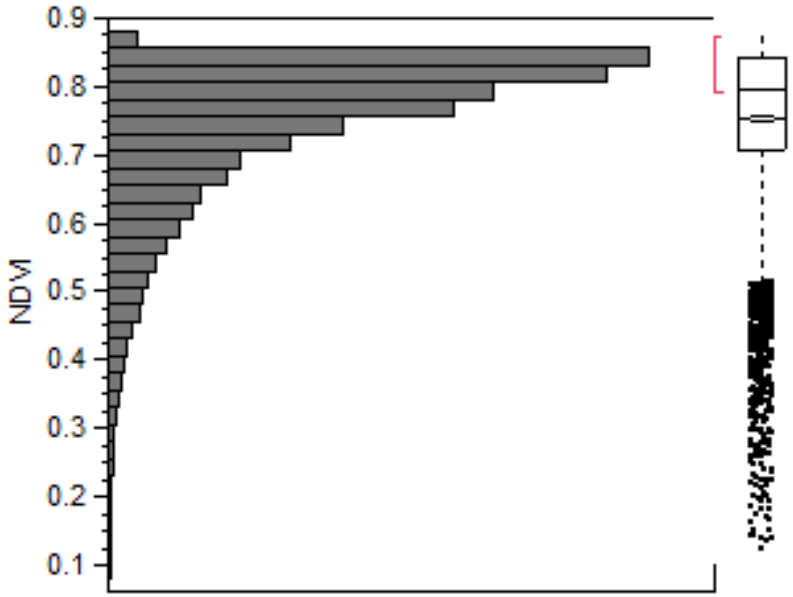
NDVI´s distribution



Quantiles	
100.0%maximum	0.8879
99.5%	0.87838
97.5%	0.87147
90.0%	0.86029
75.0%quartile	0.84126
50.0%median	0.79451
25.0%quartile	0.70842
10.0%	0.58261
2.5%	0.41347
0.5%	0.25401
0.0%minimum	0.11862

Moments	
Mean	0.7538456
Std Dev	0.1230301
Std Err Mean	0.001378
upper 95% Mean	0.7565468
lower 95% Mean	0.7511443
N	7971

- NDVI saturates asymptotically

- R5 best fit NDVI:Yield

- Late MG: R5 → NDVI saturates

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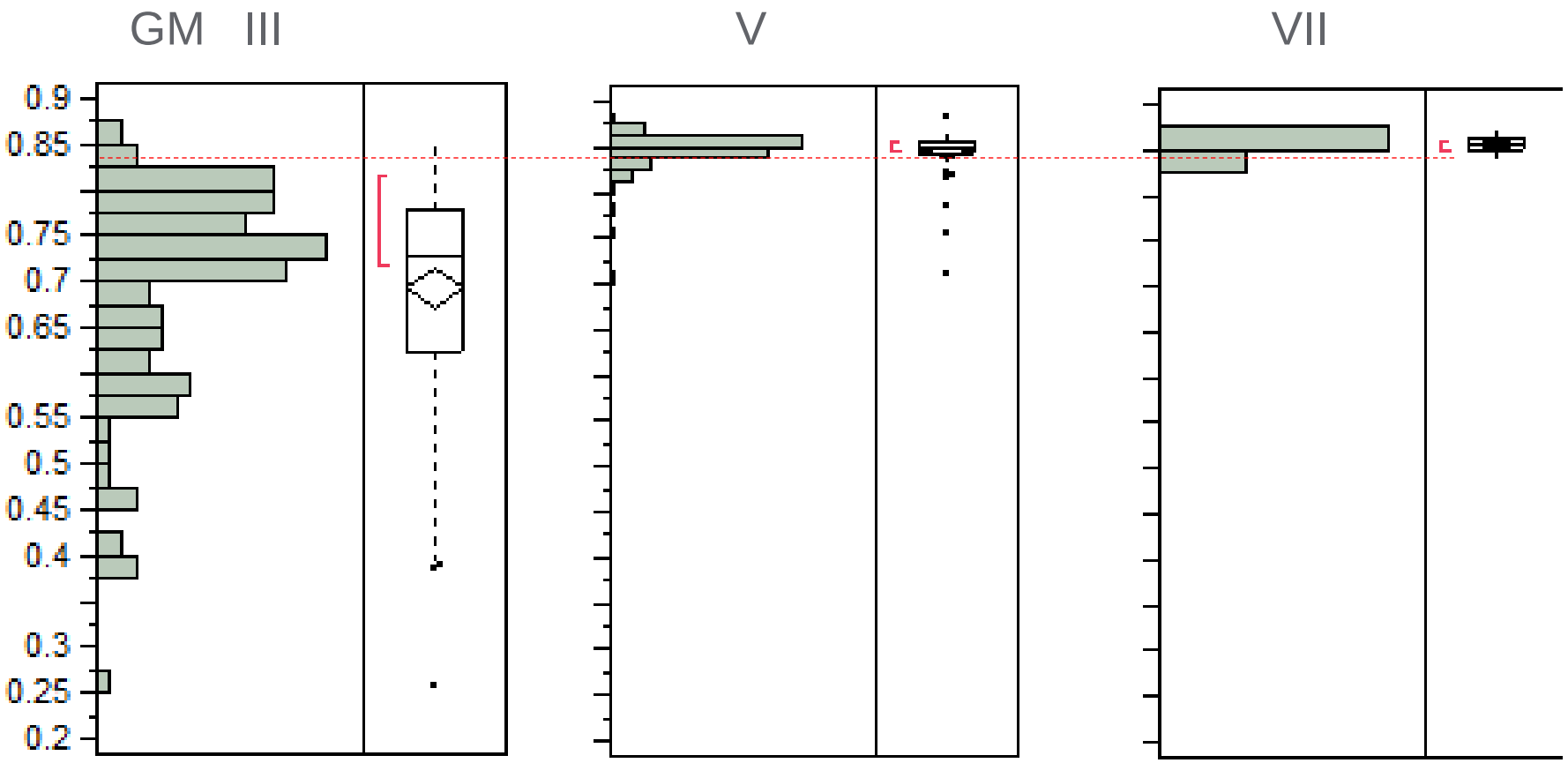
Maturity Groups – NDVI´s distribution of MG III, V & VII (Stage R4)



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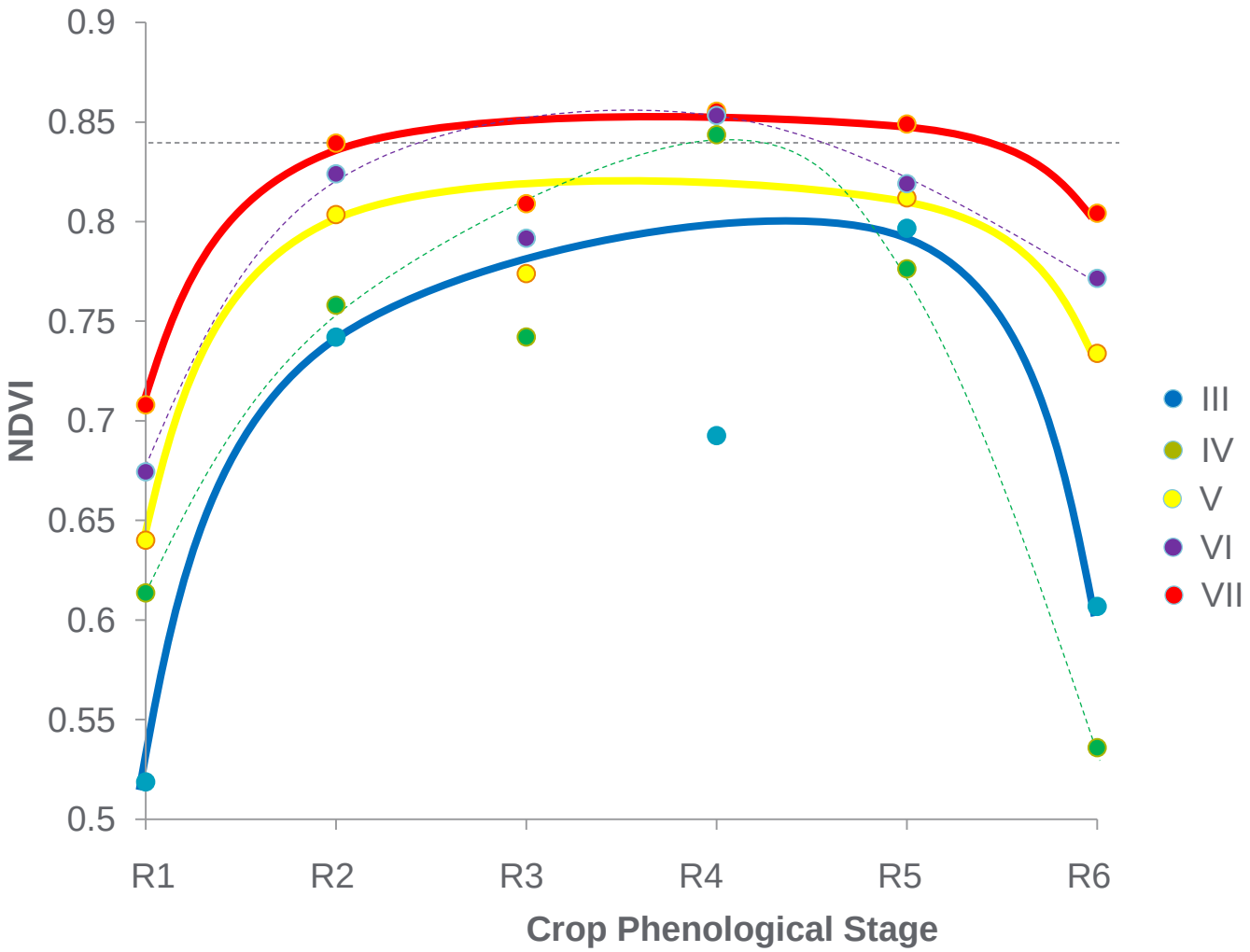
NDVI average - in different phenological stages, for different MG



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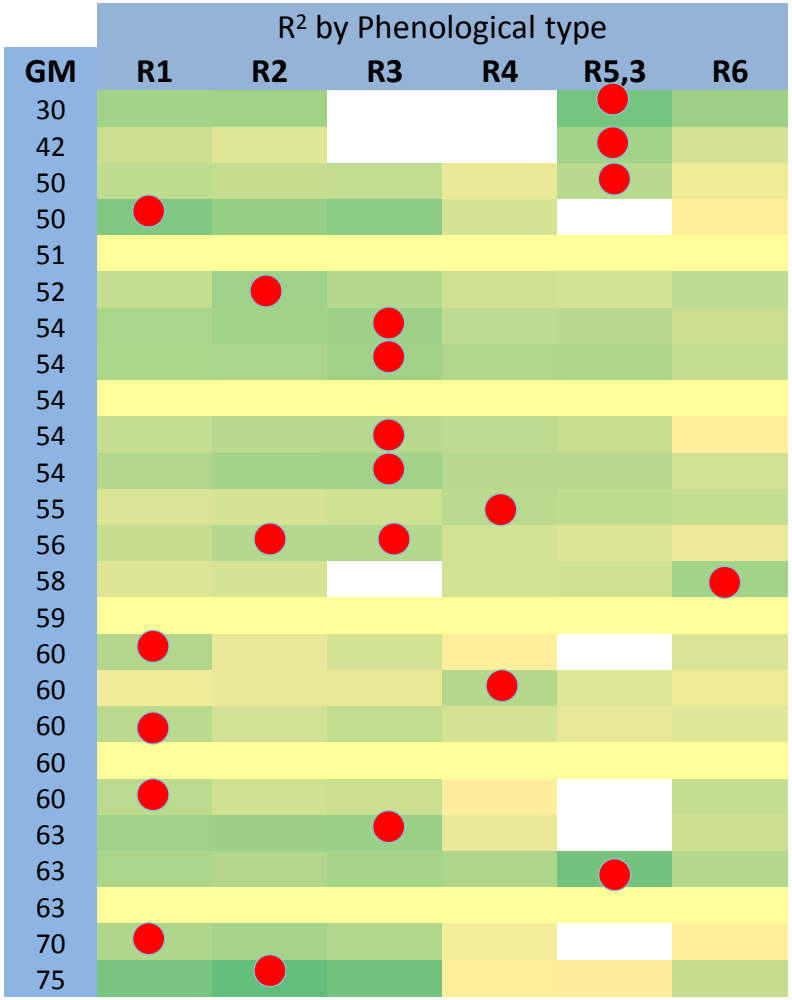
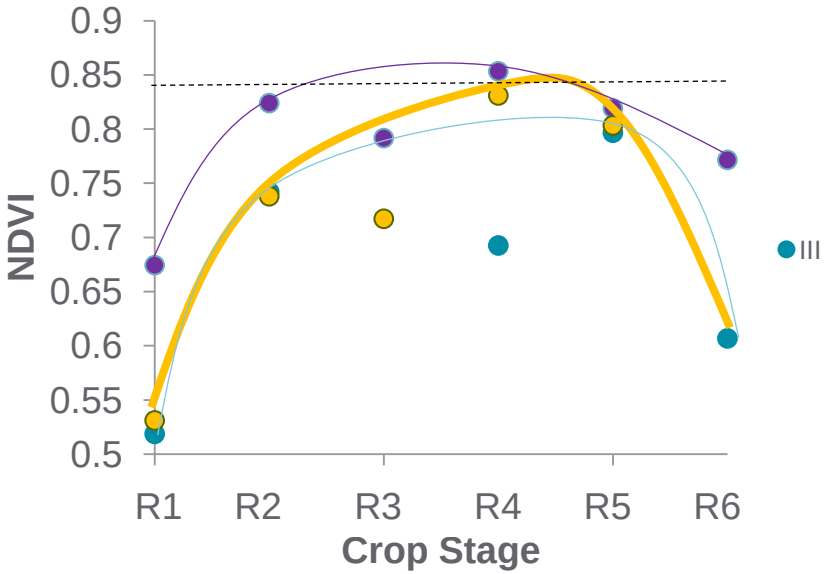
Adjustments by phenological stage





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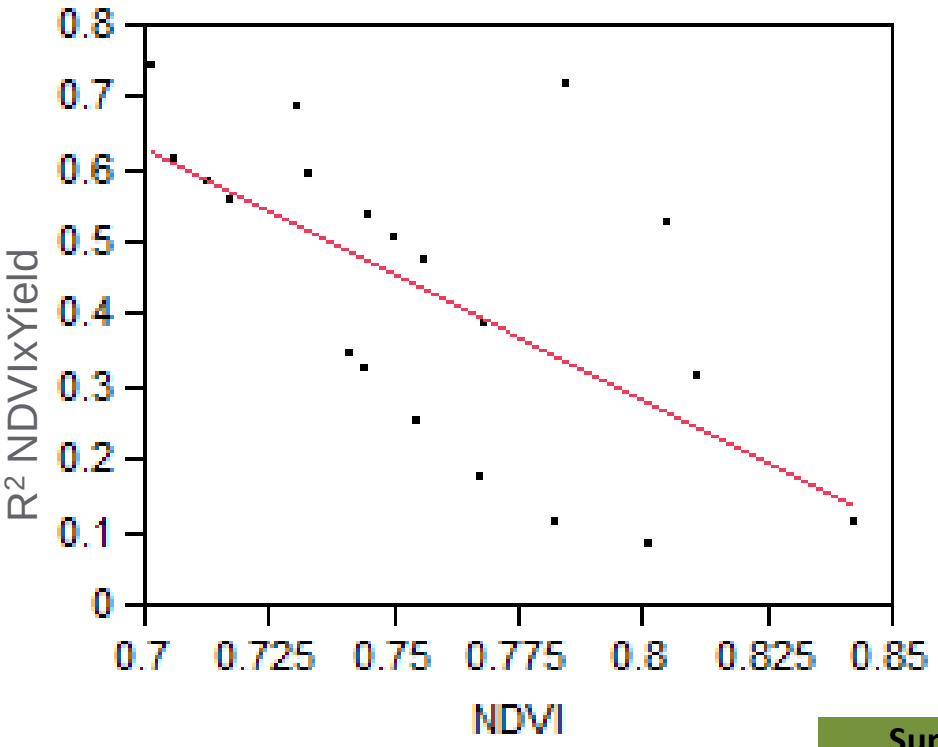
Yield vs. NDVI – Adjustment



R^2 between Yield and NDVI decrease linearly at higher NDVI

Summary of Fit	
RSquare	0.403756
n	20

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	3.071791	0.758297		4.050.0007*
NDVI	-3.4897	0.999551		-3.490.0026*

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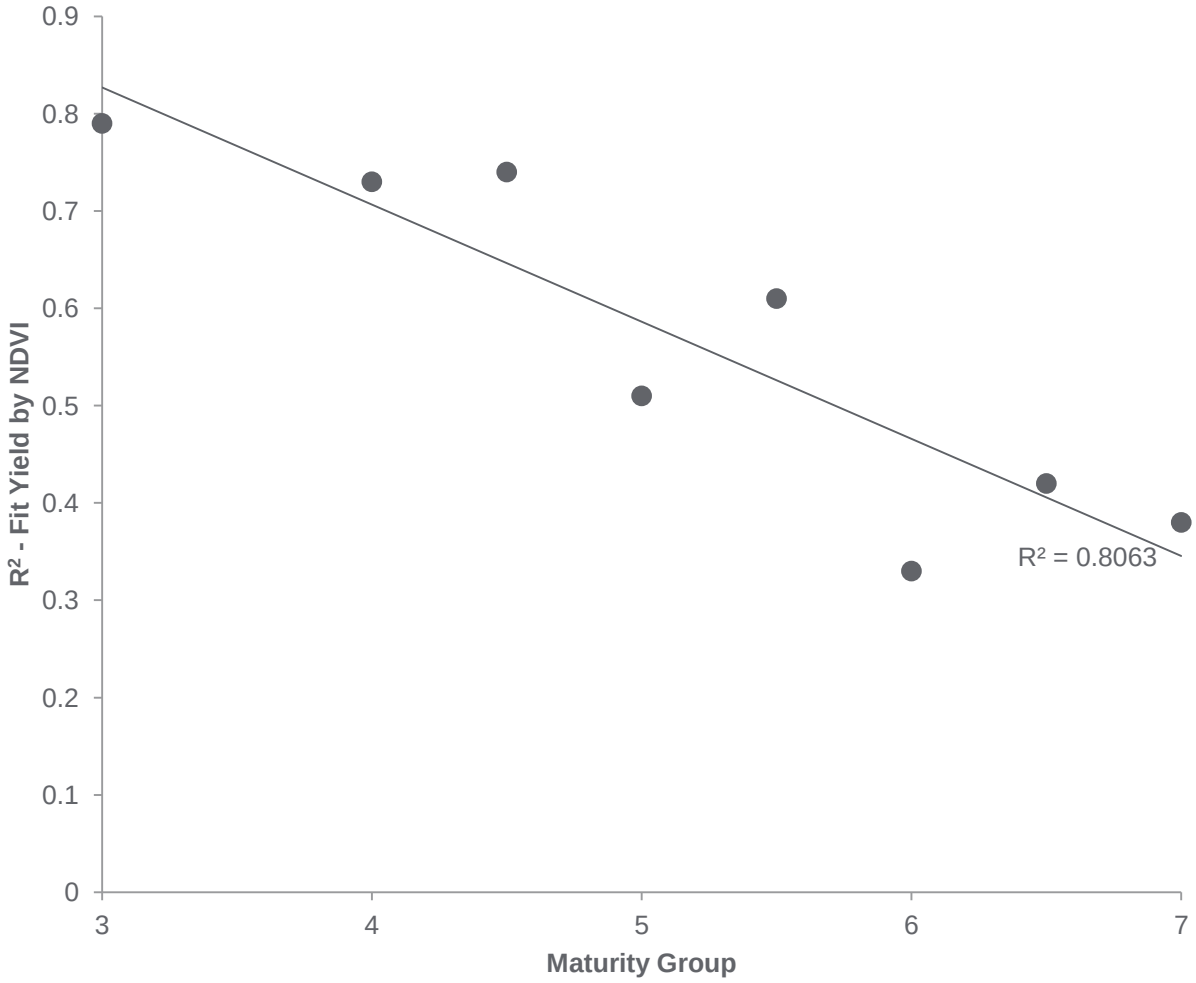
R^2 of grain yield by NDVI vs. Maturity Group



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WDRVI – Wide Dynamic Range Vegetation Index

WDRVI = (*a * ρNIR–ρVIS)/(a *ρNIR+ρVIS),*

a: coefciciente de ponderación con valores de 0,1-0,2

- The sensitivity of the **WDRVI** to **moderate-to-high LAI** (between 2 and 6) was at least three times greater than that of the NDVI
- By enhancing the dynamic range while using the same bands as the NDVI, the WDRVI enables a more robust characterization of crop physiological and phenological characteristics.
- WDRI complements the NDVI and other vegetation indices that are based on the VIS and NIR spectral bands.

Anatoly Gitelson

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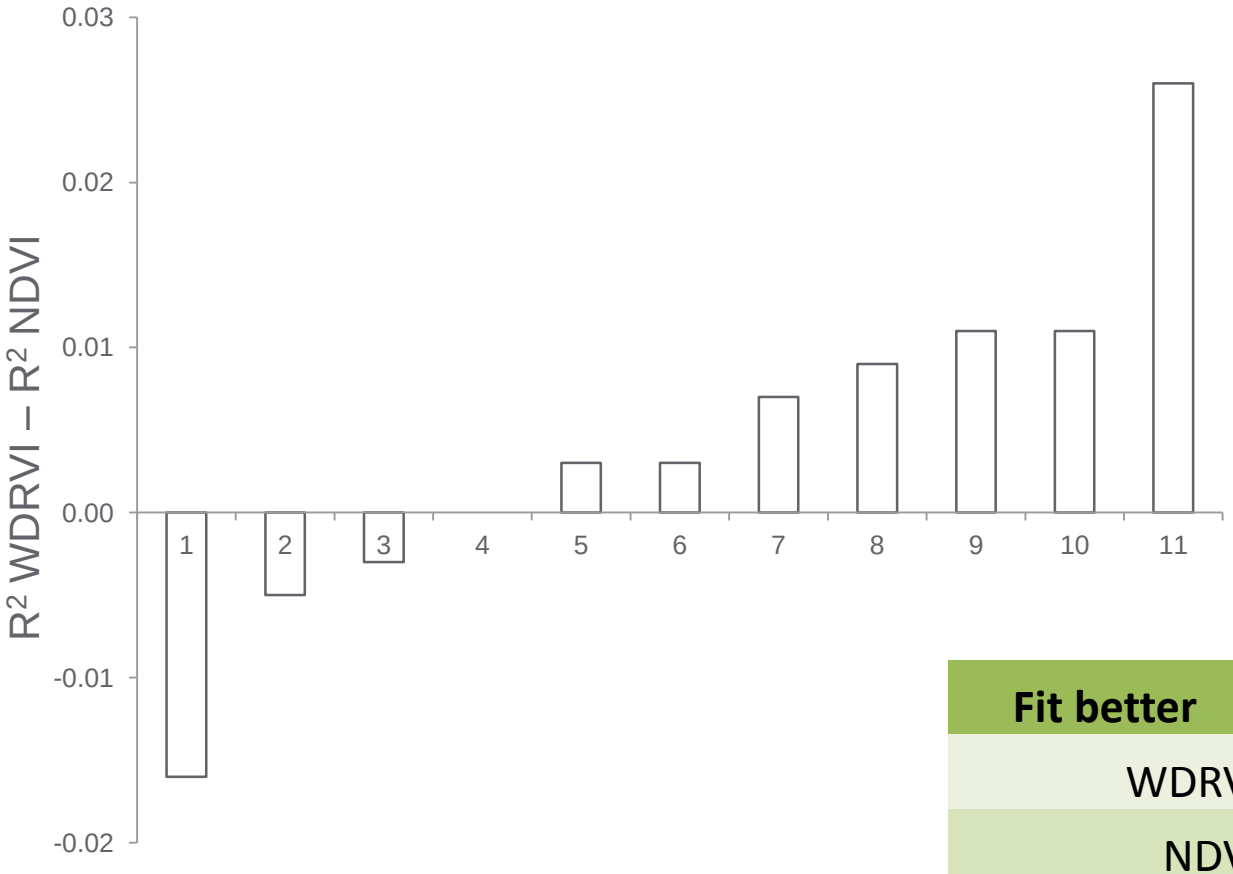
WDRVI – Wide Dynamic Range Vegetation Index



Pedegrees with MG>5

(only the ones that correlated)

Fit better	% cases	R^2 improvement
WDRVI	0.28	0.014
NDVI	0.11	0.015
indiference	0.22	
no correlation	0.39	

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Conclusions

- MG III, IV & V (earlier)
  - Good adaptation to the area
  - Grain Yield has a strong correlation with canopy reflectance
- MG V (later), VI & VII
  - Regular adaptation to the area → developed excessive LAI
  - NDVI saturation in periods before stage R5

Maturity Group	Crop Stage
III	R5

MG III – Stage R5 was the best moment

MG IV – Stage early R5 was the best moment

MG V – Stage R3 was the best moment for PYT s Pedegrees.

MG VI & VII – Stage R1-R3 was the best moment, because of the exceeding aboveground biomass.

*Cultivars of MG V and VI without high LAI s fitted better with grain Yield in stage R5

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Conclusions

- There was a negative linear correlation between R^2 of grain Yield vs. NDVI, at higher NDVI.
- Adjustment between Yield and NDVI fell at a rate of twelve percent per unit of MG (for MG from III to VII)
- WDRVI was inconsistent to replace NDVI in high LAI´s situations.

Thank you